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Ring Clinal Variation in Morphology of the Green Odorous Frog (*Odorrana margaretae*)

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Abstract The green odorous frog (*Odorrana margaretae*) has an interesting ring-shaped divergence pattern around the Sichuan Basin and documenting its morphological variations is essential in understanding its evolutionary history. Using curvilinear models, we detected significant geographical clinal variations in morphological traits, particularly sizes, of female *O. margaretae*. Males had significantly smaller sizes than females, and also had smaller variation ranges than females. One major trend of morphological variations was clinal: populations from the west tended to have a larger size with wider head and longer posterior limbs than populations from the east. Species history, with an early extended isolation and two subsequent secondary contacts, may explain most of the geographical clinal variations of *O. margaretae*. Bioclimatic factors may also contribute in explaining the variance of morphology.

Keywords geographical clinal, intraspecific variation, morphology, *Odorrana margaretae*

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1. Introduction

The odorous green frog (*Odorrana margaretae*) displays an interesting ring-shaped divergence pattern around the Sichuan Basin of western China, much like a ring species (Qiao *et al.* 2018). It is a large stream-dweller primarily distributed in the mountains of western China with a few sporadic distribution records at the east (Figure 1A; Fei *et al.*, 2009). Using DNA sequence and microsatellite DNA data, Qiao *et al.* (2018) examined its phylogeographical history. The current ring-shaped distribution pattern likely originated from two refugial populations, one at the west and the other at the southeast of the Sichuan Basin. Both populations expanded around the Basin and formed two contact zones. Extensive admixture occurred at the south contact zone, which became an evolutionary 'melting pot', and the second contact zone at the northwestern corner of the Basin only revealed limited hybridization and partial reproductive isolation has developed between the two expansion fronts (Qiao *et al.*, 2018). Furthermore, the chain populations demonstrated a strong isolation by distance pattern around the Basin, suggesting that the genetic variation were mostly gradual and continuous (Qiao *et al.* 2018).

Morphological variations among these populations have been noticed (Fei *et al.*, 2009; Shen *et al.*, 2009). For example, Fei *et al.* (2009) reported that individuals from the western populations (Mt. O'mei) are larger than individuals from the eastern (Wushan) and southern (Anlong) populations. Large ventral color pattern variations were also described (Fei *et al.* 2009). With its ring-shaped divergence pattern, we would

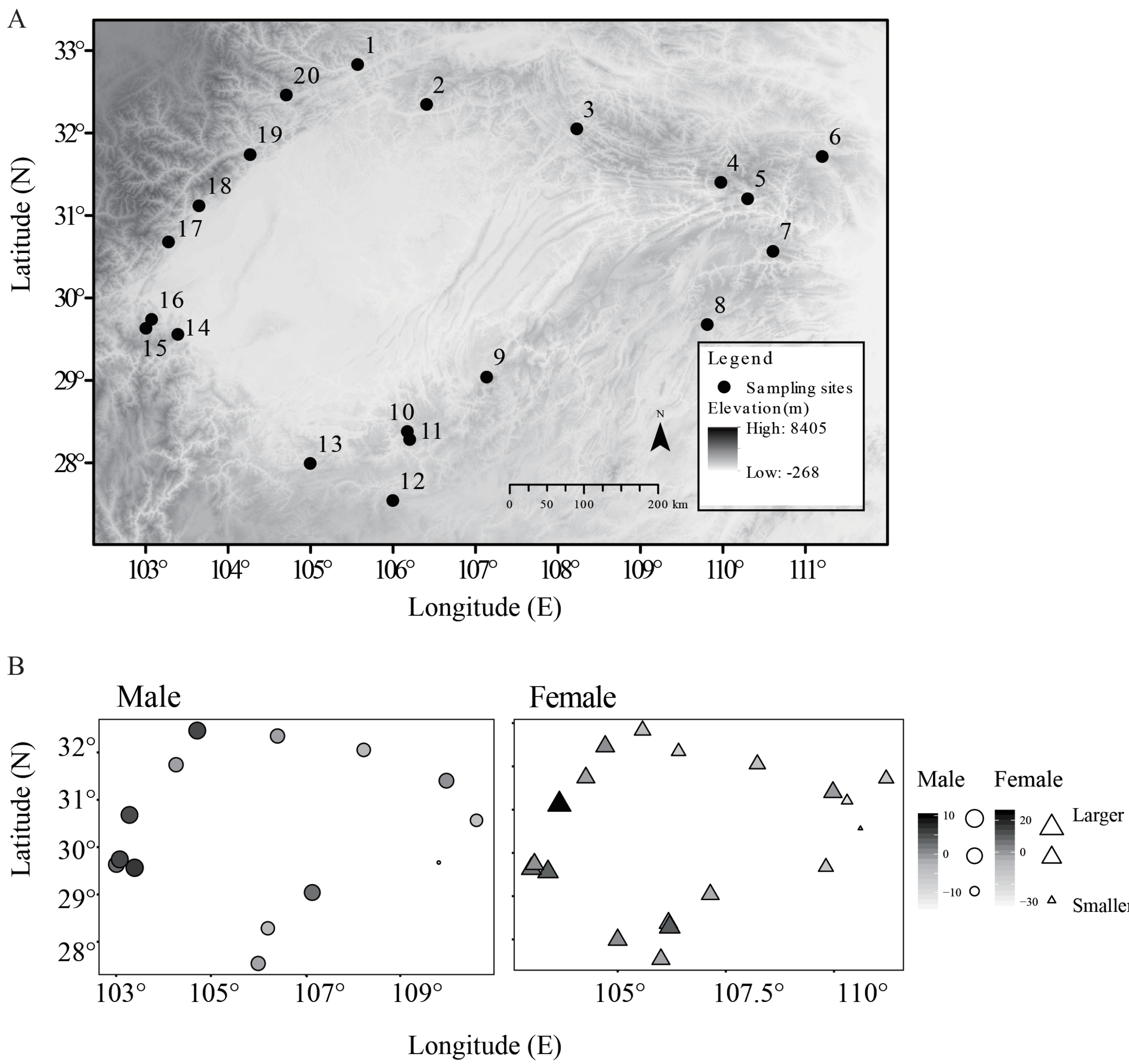

Figure 1 A: Sampling sites of *Odorrana margaretae* around Sichuan Basin. B: Patterns of geographical clinal variation in male and female morphology: mean scores of PC1 from every site were plotted in coordinates. The grey scale and size of symbols are according to increasing size.

expect morphological clinal variations around the Sichuan Basin, in a similar fashion to genetic variation. Numerous early works have demonstrated that both primary differentiation and secondary contact can result in clinal variation (e.g. Endler 1977), and clinal variation in morphological traits has been well documented in various animal groups (e.g, mammals, Okeefe *et al.*, 2013; John and Richmond, 1993; turtles, Ennen *et al.*, 2014; geckos, Fitness *et al.*, 2012; frogs, Poynton and Loader, 2008; fishes, Moore and Hendry, 2005). Understanding the significance and the mechanisms of clinal variation will lead to a broad understanding of fundamental evolutionary processes such as local adaptation, population differentiation, and ultimately, speciation (Mayr, 1942; Endler, 1977).

In this study, we examined the morphological traits of *O. margaretae* populations around the Sichuan Basin. Our objectives are 1) documenting morphological variations quantitively and 2) exploring potential causes of these variations. We specifically considered two alternative causes, its evolutionary history in particular the formation of its ring distribution, or climatic factors. If the evolutionary history is the leading cause, we would expect a clinal variation follow the ring distribution; if climate dominates these variations, we

would expect a strong correlation between morphological traits and climatic factors, irrelevant to its ring distribution.

2. Materials and Methods

2.1. Data collection A total of 152 adult *O. margaretae* specimens (61 females, 91 males) from 20 locations around the Sichuan Basin were measured (Appendix Table S1, Figure 1A). Specimens were collected from 1956 to 2018 (Appendix Table S1), and are deposited at the Herpetology Collection of the Chengdu Institute of Biology, Chinese Academy of Sciences (in 10% formalin), and at the Henan Normal University. We selected 21 external body characteristics that are most commonly used for anurans (Table 1). All measurements were collected using a Mitutoyo ditgimatic caliper (Mitutoyo Corp., Japan) and measured to the nearest 0.01mm.

For environmental factors, 19 bioclimatic variables for the years 1970-2000 with a spatial resolution of 30 arc-seconds resolution (~1km) were first obtained from WorldClim version 2 database (http://www.worldclim.org/; Fick and Hijmans 2017), and extracted by site using ArcMap 10.2. Eleven of these variables are related to variations in temperature (BIO1-11, Table 2), and eight are related to variations in precipitation (BIO12-19, Table 3).

2.2. Data Analysis We first compared the snout-vent length (SVL) between females and males using ANOVA. Since significant differences were detected, all downstream analysis was conducted separately for males and females.

The 21 morphological measurements were first subjected to a principal component analysis (PCA). For morphological traits, we plotted the mean scores value of PC1 from every site. Wilcoxon rank sum test was used to compare the morphological data among different geological groups by using the first principle component score values. The Wilcoxon tests were conducted on an online calculator (https://astatsa.com/WilcoxonTest/).

To avoid autocorrelation, a PCA was also performed on the 19 bioclimatic variables. Values of bioclimatic variables with loading score greater than 0.2 on PC1 and PC2 were then plotted around the Basin. The PCA analyses were carried out with the 'prcomp' function using R (v. 3.6.1), and plotting was conducted using R package 'ggplot2' (Wickham 2016).

Table 1 Summary of 21 morphological characteristics and the corresponding PC1 (PC1morph) loadings on PCA in *Odorrana margaretae*. All measurements are in unit of millimeter. Values in bold represent loading absolute values greater than 0.2. Asterisks indicate significant difference between the sexes.

Body measure	Male		Female	
	Mean (±SD)	PC1morph (79.37%)	Mean (±SD)	PC1morph (90.57%)
Snout-vent length, SVL*	72.75 (±5.24)	**0.6205**	87.67 (±10.21)	**0.6586**
Head length, HL	22.04 (±1.98)	0.1817	25.83 (±2.35)	0.1236
Head width, HW	24.39 (±1.97)	**0.2194**	30.35 (±3.91)	**0.252**
Snout length, SL	9.44 (±0.88)	0.0541	11.23 (±1.22)	0.0546
Internarial distance, IND	8.61 (±0.68)	0.059	10.37 (±1.09)	0.0596
Interoptic distance, IOD	5.93 (±0.75)	0.0388	6.87 (±1.26)	0.0563
Antoptic distance, AOD	12.66 (±1.03)	0.1041	15.26 (± 1.88)	0.1135
Postoptic distance, POD	19.28 (±1.52)	0.155	22.72 (±2.54)	0.1536
Eye-nostril distance, EN	5.20 (±0.45)	0.0363	6.11 (±0.75)	0.0353
Eye diameter, ED	8.72 (±0.71)	0.0504	9.82 (±0.87)	0.0404
Tympanum diameter, TD	3.91 (±0.37)	0.0178	4.28 (±0.46)	0.0154
Hand length, HAL	18.29 (±1.50)	0.1457	21.50 (±2.51)	0.138
Forearm length, FLL	21.19 (±1.51)	0.1589	25.04 (±2.68)	0.1635
Forearm width, FLW	7.71 (±1.27)	0.0691	8.14 (±1.26)	0.0352
Foot length, FL	42.93 (±3.36)	**0.3688**	50.99 (±5.32)	**0.3335**
Tarsus length, TSL	20.68 (±1.56)	0.1522	24.30 (±2.58)	0.1569
Inner metatarsal tubercle length, IMTL	4.28 (±0.51)	0.0431	5.15 (±0.74)	0.0378
Inner metatarsal tubercle width, IMTW	1.96 (±0.28)	0.0138	2.32 (±0.37)	0.0148
Tibia length, TL	44.52 (±2.99)	**0.3476**	52.56 (±5.32)	**0.3414**
Tibia width, TW	10.58 (±1.25)	0.1136	13.17 (±2.08)	0.1223
Thigh length, THL	42.35 (±3.28)	**0.3752**	50.03 (±5.50)	**0.3494**

Table 2 The loadings on the first two components (PC1bioc and PC2bioc) of PCA of 19 bioclimatic factors. Values in bold represent loading absolute values greater than 0.2 (the cutoff was inferred from Sidlauskas *et al.*, 2010).

Bioclimatic factors	PC1bioc (86.36%)	PC2bioc (12.48%)
BIO1 _ Annual Mean Temperature	-0.0018	-0.0066
BIO2 _ Mean Diurnal Range (Mean of monthly (max temp - min temp))	-0.0021	-0.0104
BIO3 _ Isothermality (BIO2/BIO7) (* 100)	-0.0069	-0.0376
BIO4 _ Temperature Seasonality (standard deviation *100)	0.0641	**0.3896**
BIO5 _ Max Temperature of Warmest Month	-0.0019	-0.0047
BIO6 _ Min Temperature of Coldest Month	-0.0015	-0.0058
BIO7 _ Temperature Annual Range (BIO5-BIO6)	-0.0004	0.0011
BIO8 _ Mean Temperature of Wettest Quarter	-0.0012	-0.0025
BIO9 _ Mean Temperature of Driest Quarter	-0.0023	-0.0105
BIO10 _ Mean Temperature of Warmest Quarter	-0.0007	-0.0007
BIO11 _ Mean Temperature of Coldest Quarter	-0.0023	-0.0105
BIO12 _ Annual Precipitation	**-0.7526**	**0.5832**
BIO13 _ Precipitation of Wettest Month	-0.1891	**-0.2453**
BIO14 _ Precipitation of Driest Month	-0.0165	0.0459
BIO15 _ Precipitation Seasonality (Coefficient of Variation)	-0.0032	-0.1301
BIO16 _ Precipitation of Wettest Quarter	**-0.4309**	**-0.4373**
BIO17 _ Precipitation of Driest Quarter	-0.0543	0.1523
BIO18 _ Precipitation of Warmest Quarter	**-0.4492**	**-0.4354**
BIO19 _ Precipitation of Coldest Quarter	-0.0543	0.1523

Table 3 Regression analysis for morphology, geography and bioclimatic factors. Six regression models are compared. (1) The cubic polynomial regression model that morphology (PC1morph) is regressed onto geographical coordinates (x, longitude; y, latitude); (2) (3) The linear regression model that morphology is regressed onto bioclimatic factors (PC1bioc and PC2bioc); (4) The linear regression model that morphology is regressed onto locality altitude; (5) The linear regression model that morphology is regressed onto the year of collection; (6) The full regression model that morphology is regressed onto geographical coordinates as well as bioclimatic factors. Significant predictors are indicated by "*" ($P < 0.05$). R^2 is the correlation coefficient between the outcomes and the predictors, and *P*-value represents significance of the regression analysis. Akaike information criterion, AIC, was used to compare the goodness of fit of the models.

Candidate models	Male				Female			
	Significant Predictors	R^2(%)	*P*-value	AIC	Significant Predictors	R^2(%)	*P*-value	AIC
(1) PC1morph~polym (x,y)	-	0.8393	0.2167	81.32	xy*	0.7725	0.0414	143.75
(2) PC1morph~PC1bioc	-	0.0021	0.8758	90.88	-	0.0008	0.91	155.87
(3) PC1morph~PC2bioc	PC2bioc*	0.6166	0.0009	**77.49**	PC2bioc*	0.3397	0.0088	148
(4) PC1morph~alt	-	0.1271	0.2108	89.01	-	0.0199	0.5651	155.5
(5) PC1morph~year	-	0.0133	0.6951	90.73	-	0.0389	0.4187	155.13
(6) PC1morph~polym (x,y) + PC2bioc	-	0.8402	0.3901	83.24	y*, xy*, x^2y*	0.8224	0.038	**141.05**

For testing correlation between morphological traits and geographical and climatic factors, six models were analyzed and compared (Table 3). First, a trend surface analysis (Borcard *et al.*, 1992; Legendre and Legendre, 1998; Botes *et al.*, 2006; Cardini *et al.*, 2007) was applied to fit geographical coordinates to variations in morphology, taking into account of nonlinearities. The morphological variables were regressed onto a third-order polynomial of longitude and latitude:

$$f(x,y) = b_0 + b_1x + b_2y + b_3x^2 + b_4xy + b_5y^2 + b_6x^3 + b_7x^2y + b_8xy^2 + b_9y^3,$$

where x and y are longitude and latitude respectively. Second, a basic ordinary least squares (OLS) model was used for fitting bioclimatic factors, locality altitude, and the year of collection to morphological variations separately. Finally, a full model evaluation, including geographical variables and other variables that were identified as significant predictors in the OLS model, was conducted to explain variance in morphology.

The first principle component of PCA on morphology and the first two principle components of PCA on bioclimatic factors were included in relevant models. Akaike information criterion (AIC) was used to compare the goodness of fit of the models. All correlation models were conducted separately on males and females. The 'lm' function in R was used to archive all the regressions.

3. Results

Morphological data revealed significant sexual size dimorphism in *O. margaretae*. The SVLs of females were significantly larger than males (Table 1). The raw measurement data are provided in Appendix Table S2.

The principle component analysis on 21 morphological measurements revealed that the first axis explained the vast majority of total variations in both males (PC1, 79.37%; PC2, 5.28%) and females (PC1, 90.57%; PC2, 3.33%). For both males and females, PC1 represented mostly body length (SVL), head width (HW) and hind leg length (FL, TL, and THL) (loading > 0.2; Table 1). The highest loading was for snot-vent length (SVL) (males: 0.6205; females: 0.6586).

The males and females of *O. margaretae* displayed similar variation patterns of morphology around the Sichuan Basin, but the pattern was stronger in females than in males (Figure 1B). Individuals at the eastern region of the Basin (site 7–8, Figure 1) had the smallest body size, with mean PC1 scores of -12.03 (males) and -26.37 (females). The body size increased both westward and northward around the Basin, but the western populations (site 14–20) attained a much larger size (mean PC1 scores: males, 4.28; females, 9.13) than the northern populations did (site 1-6, the mean PC scores: males, -0.98; females, -11.04), with a significant difference between those two regions (males, Wilcoxon W = 0.99, P < 0.05; females, Wilcoxon W = 3.06, P < 0.005). The southern populations possessed an intermediate size (site 9-13, the mean PC1 scores: males, 0.99; females: 3.06) between the eastern and western populations (Appendix Table S3). No significant difference was found between the southern populations and others.

PCA of 19 bioclimatic factors summarized 98.84% of the variation in the first two components, with PC1 explaining 86.36% of total variance, and PC2 explaining 12.48% (Table 2). PC1 mostly represented the precipitation related factors (e.g., BIO12, BIO16 and BIO18), with the highest loading for annual precipitation (BIO12). PC2 was correlated positively with annual precipitation (BIO12) and temperature seasonality (BIO4), and moreover, was negatively correlated with several precipitation factors (e.g., BIO13, BIO16 and BIO18). For precipitation, the annual precipitation was high in both eastern and western regions, and became drier toward the north. The west of the basin showed noticeably abundant rainfall in the wettest month/quarter and warmest quarter (Appendix Figure S1A). As for temperature, the western region possessed a more stable seasonality than others; the temperature seasonality reduced gradually from east to west (Appendix Figure S1B).

We detected a significant correlation between geography and morphology in females, and between bioclimatic factors and morphology in both sexes (Table 3). The best-performing model in females was the full regression model that included both geographical and bioclimatic factors (with the minimum AIC: 141.05), and the spatial components (y, xy and x^2y) were significant in explaining the morphological variations. The model that included only geographical components also provided good fit for morphology (AIC: 143.75), and geography explained 77.25% the variance of the morphological variations in females (Table 3). Male morphology was not significantly correlated with geography, but was significantly correlated with PC2 of the bioclimatic factors ($F_{3,10}$ = 9.547, P < 0.005, Table 3). Neither locality altitudes nor collecting years showed any significant effects on morphology.

4. Discussion

There are substantial morphological variations within the green odorous frog around the Sichuan Basin. The variations exhibit a clear geographical clinal pattern. While the eastern populations possess the smallest body size, the size increases along the southern margin of the Basin and the western populations attain the largest body size. Along the northern margin, populations also increase their body sizes, albeit to a less degree compared to the western populations (Figure 1B, Table 1). Furthermore, sexual size dimorphism is significant; females are larger than males and also show a larger variation range than males. For example, females have an SVL range of 67.96–109.69 mm, while the range is 58.89–84.67 mm in males (Appendix Table S2, Table 1).

Climate has a clear effect on morphological traits of this species. We detected a significant correlation between the morphological traits and PC2 of climate data (Table 3). Nevertheless, the climate data did not act as a significant predictor in the full model; this is likely because of the commonly observed autocorrelation between climate and geography. Climate often has significant influence on phenotypic variations both plastically or genetically, which is well-documented (e.g. Hubbe *et al.*, 2009; Siepielski *et al.*, 2017; Urban *et al.*, 2014). The western region of the Sichuan Basin has a warm and stable climate that is wet overall and receives abundant rainfall during the wettest period of the year (Appendix Figure S1). These favorable environmental factors likely promote growth. Furthermore, high environmental

humidity, long wet periods, and mild winters often improve larval survivorship and breeding success of those aquatic breeders (Banks *et al.* 1994; Blaustein *et al.*, 2010; Scherer *et al.*, 2008). All of these may have contributed to the large body size of green odorous frogs in this region. The initial isolation of the species (Qiao *et al.* 2018) likely produced a west-large and east-small dichotomy, and during the westward expansion of the east refugial population along both the southern and the northern margins of the Basin, the body sizes increased. Although this parallelism could be caused by several other mechanisms (e.g. chance, boundary effect), climatic factors likely played an important role. The observed climatic variations may have also caused several other phenotypic variations of the species. As important cues for the onset of reproduction, high temperature and precipitation may also promote an early breeding season, which is likely beneficial (Altwegg and Reyer, 2003). The breeding season of the western populations are generally earlier than the eastern populations. For example, the Mt. O'mei population at the west starts breeding during winter or early spring (Fei *et al.*, 2009), while the Mt. Tian Ping population at the east has a breeding season from late August to early September (Shen *et al.* 2016).

Species evolutionary history may also explain the observed morphological variations. The observed clinal variation is consistent with its ring distribution pattern and is compatible with the two-refugia hypothesis of its species history (Qiao *et al.* 2018). The green odorous frog likely evolved from two historical refugia formed during Pleistocene, the western region and the south-eastern region of the Sichuan Basin (Qiao *et al.*, 2018). The extended isolation period, which produced the initial genetic divergence, may have also generated the morphological difference, mostly body size difference with the eastern population being small and the western population being large. Climatic differences induced natural selection likely contributed to the observed phenotypical variations, while genetic drift likely also played an important role, as it has been demonstrated in many cases (e.g., cichlids, Arnegard *et al.*, 1999; Van Oppen *et al.*, 1997; Markert *et al.*, 1999). Post-glacial expansion and subsequent hybridization likely produced the geographical clinal variation (Figure 1B). The genetic data suggested that the two refugial populations expanded around the Basin and re-connected at two zones. A broad contact zone at the south, which became an evolutionary 'melting pot' (Dufresnes *et al* 2016; Qiao *et al.*, 2018), incurred extensive admixture between the two refugial populations. The intermediate phenotypes of the southern populations are likely consequences of this admixture (Figure 1B, Wilcoxon test on southern and western populations showed no significant). The second contact zone is located at the north-western corner of the Basin, where only limited gene exchange occurred. Concordantly, the morphological variations also showed significant difference between the western and northern populations with limited intermediate forms (Wilcoxon test between northern and western populations were significant in both sexes: males, Wilcoxon $W = 0.99$, $P < 0.05$; females, Wilcoxon $W = 3.06$, $P < 0.005$).

It is probably difficult to completely reject one of the two alternative hypotheses, as they are not mutually exclusive and partially correlated. In the case of the green odorous frog, its evolutionary history combined with climatic factor clearly provides a better explanation of its morphological variation than either hypothesis itself.

We study also rejected several other factors that often contribute to morphological variations. We tested the year of collection and locality altitude, and neither is correlated with the morphological traits that we examined (Table 3). Nevertheless, our small sample sizes may limit the detecting power of our analysis. Furthermore, we did not determine the ages of our samples. Since amphibians have indeterminate growth, the impacts of sample age need to be taken into account for formulating hypotheses in future studies.

Odorrana margaretae has a ring-species alike genetic divergence pattern around the Sichuan Basin, which make it an excellent model system for studying speciation. This study revealed a compatible geographical clinal variation of its morphology. Future work on other phenotypic variations, particularly these may potential link to reproductive isolation, are essential to understand it species history and hybridization dynamics.

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Appendix

Table S1 Sample site and sample size information for specimens of the odorous frog *Odorrana margaretae*.

Site	Group	Location	nSamples	nMales	nFemales	Coordinates	Elevations(m)	Collected year
1	north	Ningqiang, Qingmuchuan	1	0	1	105.57457E, 32.83312N	1071	2012
2	north	Nanjiang, Guangwushan	22	19	3	106.40704E, 32.34705N	1412	2012
3	north	Wanyuan, Hua'eshan	10	6	4	108.22810E, 32.05360N	1111	2018
4	north	Chongqing, Wushan	16	12	4	109.97463E, 31.40330N	765	1956
5	north	Shengnongjia, Muyuxia	1	0	1	110.30216E, 31.20768N	743	2011
6	north	Baokang, Wudaoxia	1	0	1	111.20576E, 31.71790N	519	2012
7	east	Changyang, Xiufengqiao	6	5	1	110.60970E, 30.56640N	1430	2018
8	east	Sangzhi, Badagongshan	9	4	5	109.81263E, 29.67515N	1138	2011
9	south	Nanchuan, Jinfoshan	10	7	3	107.14056E, 29.04139N	793	2017
10	south	Hejiang, Zihuai	1	0	1	106.17358E, 28.37992N	763	2011
11	south	Zunyi, Xishui	10	5	5	106.20278E, 28.28610N	1182	2015
12	south	Bijie, Dafang	9	6	3	105.99911E, 27.54319N	852	2014
13	south	Junlian, Daxueshan	3	0	3	104.99920E, 27.99139N	967	2011
14	west	Leshan, Mt. O'mei	11	7	4	103.38918E, 29.56418N	749	2012
15	west	Hongya, Yanziyan	9	5	4	103.00639E, 29.63583N	1105	1956
16	west	Ya'an, Yanchang	16	7	9	103.07560E, 29.74135N	919	2012
17	west	Dayi, Xilingxueshan	3	3	0	103.28039E, 30.68014N	1283	2012
18	west	Dujiangyan, Hongkou	5	0	5	103.65208E, 31.12045N	1102	2012
19	west	Anxian, Qianfoshan	4	3	1	104.264285E, 31.74066N	1141	2016
20	west	Pingwu, Laohegou	5	3	2	104.71170E, 32.46250N	1106	2018

Table S2 Raw data of 21 morphological measurements from 152 individuals of *Odorrana margaretae*.

PopID	Group	labID	Sex	SVL	HL	HW	SL	IND	IOD	AOD	POD	END	ED	TD	HAL	FLL	FLW	FL	TSL	IMTL	IMTW	TL	TW	THL
1	north	103478	F	80.04	21.73	29.26	10.71	10.22	7.55	14.03	20.8	5.5	9.96	3.64	19.67	24.08	7.09	48.43	25.57	4.55	2.1	50.68	9.8	49.82
2	north	103511	M	68.34	21.09	22.22	8.61	7.77	5.85	11.33	18.15	4.57	8.42	3.55	17.39	18.85	6.63	39.52	18.95	3.57	1.41	41.39	9.8	40.26
2	north	103527	M	68.65	20.13	22.13	9.53	8.47	6.52	12.46	18.88	4.91	8	3.71	18.44	20.05	6.89	40.01	18.45	4.07	2.14	42.15	10.83	41.24
2	north	103529	M	74.03	20.48	23.59	9.36	8.82	6.38	12.38	20.88	4.98	9.05	3.76	18.86	20.26	9.4	43.45	19.19	4.36	2.31	43.24	10.89	43.49
2	north	103530	F	83.65	25.54	28.53	12.74	11.56	6.39	15.77	21.67	5.9	9.12	4.51	16.84	24.62	7.21	49.8	21.55	6.12	3.14	50.36	12.32	50.39
2	north	103532	F	72.07	24.66	24.06	9.55	9.7	5.87	12.71	18.41	5.14	9.26	5.01	16.87	22	9.19	44.83	20.86	4.73	2.1	44.99	11.12	44.69
2	north	103534	M	78.7	21.11	24.69	10.42	9.25	6.13	13.03	18.85	5.27	8	4.38	20.06	21.42	9.08	43.38	19.67	5.22	1.93	43.91	11.68	42.68
2	north	103535	M	67.13	18.69	21.25	9	7.95	5.04	11.3	18.26	4.6	6.72	3.12	17.52	19.14	6.68	38.73	17.76	3.92	1.55	39.62	9.74	37.81
2	north	103536	M	76.89	21	23.62	10.72	8.85	6.69	13.51	19.67	5.23	9.11	4.31	18.04	20.64	7.94	40.8	20.29	4.06	1.85	45.05	11.7	43.23
2	north	103537	M	70.23	21.11	23.38	8.83	8.82	6.15	12.45	19.09	4.32	8.05	3.73	18.38	20.39	9.22	42.02	19.32	4.04	1.8	42.77	10.22	41.52
2	north	103544	M	72.57	21.23	23.17	8.99	8.53	5.3	12.63	19.27	4.12	7.46	4.1	19.11	19.53	7.35	39.07	19.41	4.38	2.02	41.76	11.18	41.31
2	north	103545	M	76.82	23.44	25.7	9.83	8.78	6.08	12.63	20.91	4.92	9.61	4.49	20.14	21.93	9.19	44.64	20.12	5.26	2.62	46.3	11.62	45.5
2	north	103546	M	71.93	21.77	23.83	9.08	8.61	6.03	12.07	20.34	5.89	9.63	3.66	18.76	20.66	9.54	42.22	20.28	3.95	1.79	43.09	10.94	40.95
2	north	103547	M	73.89	20.6	23.57	9.08	8.97	7.3	12.71	20.25	4.95	8.11	4.48	18.52	21.04	8.7	39.81	19.11	4.19	1.84	43.63	11.23	43.23
2	north	103548	M	74.81	22.69	25.33	10.04	8.91	6.84	13.35	20.5	5.07	9.49	4.16	18.58	21.42	8.63	41.53	19.44	4.51	2.02	43.3	11.85	43.31
2	north	103549	M	73.87	22.5	25.1	9.68	9.51	6.06	12.4	20.49	4.98	9.43	4.29	19.56	21.2	9.52	44.2	19.78	4.49	2.15	45.16	12	43.08
2	north	103561	M	75.39	21.57	24.13	10.24	9.27	6.55	12.14	19.79	5.16	8.84	3.44	20.47	21.83	9.56	44.02	20.21	4.63	2.34	44.88	10.73	44.37
2	north	103562	M	68.67	20.1	22.6	8.92	8.47	5.86	12.01	17.12	4.7	7.42	4.11	17.58	19.36	7.71	38.26	18.5	4.13	1.92	41.04	9.83	39.89
2	north	103564	M	84.67	24.46	28.19	9.96	9.49	6.54	15.38	21.98	5.27	9.07	3.99	21.27	24.22	6.9	47.36	22.72	4.73	2.85	50.55	11.67	48.59
2	north	103565	F	75.25	25.5	26.07	10.72	9.1	6.28	13.25	19.04	5.23	9.48	4.59	17.35	21.75	8.43	42.44	19.13	4.66	2.15	44.76	12.95	42.54
2	north	103566	M	65.7	18.15	21.3	8.61	7.77	5.85	11.92	17.36	4.52	7.2	3.47	16.7	19.38	6.19	35.21	19.33	3.35	1.46	40.25	9.71	37.95
2	north	103567	M	72.67	22	24.96	9.29	8.22	6.42	12.78	20.68	5.17	9.24	3.79	19.41	21.56	9.19	43.77	20.19	4.39	2.11	44.63	12.47	42.58
2	north	103568	M	70.71	20.26	23.18	9.42	8.95	7.08	12.36	18.25	5.34	8.66	4.11	19.62	20.44	8.05	40.89	19.82	4.47	1.71	42.26	11.36	42.04
3	north	6632	M	62.19	19.37	21.35	9.75	7.41	5.35	11.39	16.22	4.75	7.65	3.79	16.59	18.18	6.49	36.82	19.04	3.7	1.79	37.61	7.69	37.35
3	north	6633	M	70.25	22.17	23.18	9.85	7.59	5.69	12.05	17.39	5.73	8.29	4.19	17.54	20.39	8.39	41.91	20.11	4.47	2.01	43.85	10.18	42.84
3	north	6634	M	69.83	21.44	23.73	9.66	8.26	6.46	12.18	18.03	5.34	7.84	3.72	19.01	19.73	8.46	42.14	19.92	4.9	2.45	44.14	10.04	43.83
3	north	6635	F	84.89	24.52	28.99	10.69	9.78	5.82	14.15	21.11	5.99	9.85	4.06	23.02	25.32	7.35	49.86	25.1	4.75	2.14	53.11	12.33	49.48
3	north	6636	F	87.77	24.14	29.19	11.59	9.93	5.49	14.91	21.52	5.68	9.04	4.59	21.55	26.24	7.73	51.12	25.54	5.59	2.33	53.51	13.27	51.4
3	north	6637	F	71.88	21.76	22.42	9.72	8.39	4.77	12.06	17.41	5.06	8.51	3.54	17.77	19.56	7.92	41.22	20.35	4.49	1.69	43.22	9.56	39.61
3	north	6638	M	83.06	24.33	29.07	10.93	9.2	4.73	15.03	22.56	5.98	9.36	3.99	20.63	23.48	7.38	48.88	23.86	4.51	2.12	51.83	11.77	50.73
3	north	6639	M	65.42	19.39	21.09	8.18	7.95	4.58	11.2	17.51	4.5	8.04	3.59	16.55	19.41	6.01	38.65	18.79	3.52	1.78	40.37	8.51	37.31
3	north	6640	F	81.93	24.66	28.49	12.88	10.26	5.14	14.52	21.2	5.84	9.37	4.01	21.07	22.19	7.86	49.04	22.79	4.66	2.62	51.38	10.96	49.47

Continued Table S2

PopID	Group	labID	Sex	SVL	HL	HW	SL	IND	IOD	AOD	POD	END	ED	TD	HAL	FLL	FLW	FL	TSL	IMTL	IMTW	TL	TW	THL
3	north	6641	M	71.42	24.86	23.38	11.16	8.77	5.56	12.62	18.75	4.94	8.42	4.21	18.48	20.09	7.87	44.72	19.16	4.62	2.59	43.72	9.67	42.61
4	north	103389	F	82.11	25.45	26.36	11.43	9.43	4.86	12.33	20.45	4.89	9.31	3.76	20.74	22.87	8.26	46.53	21.66	5.17	2.01	47.38	11.7	45.68
4	north	103395	F	97.94	27	35.15	13.14	11.7	6.03	17.97	24.69	7.06	9.72	4.37	24.62	26.69	8.39	53.87	26.41	6.02	2.93	57.9	14.98	52.07
4	north	41154	F	80.2	25.43	26.52	10.08	10.34	5.62	13.03	19.86	5.3	9.44	4.16	18.46	22.61	9.21	46.02	21.27	4.27	2.26	47.02	12.15	43.31
4	north	41155	M	70.51	23.23	21.92	8.79	7.91	6.1	12.17	18.27	4.72	9.04	4.01	17.79	21.67	7.76	42.07	20.52	3.7	2.02	42.92	9.45	38.27
4	north	41156	M	77.43	26.16	24.82	9.45	9.17	6.14	13.65	19.79	5.29	9.74	3.88	16.35	21.67	7.34	45.38	23.01	5	2.26	45.27	10.83	43.91
4	north	41157	M	75.11	24.37	23.52	8.25	9.35	5.39	12.45	19.27	5.13	9.64	4.75	17.61	21.88	9.25	42.56	21.11	3.97	1.57	43.31	10.61	39.07
4	north	41158	M	76.86	24.72	25.58	8.05	9.9	5.59	13.18	19.16	4.73	9.18	3.74	17.97	22.93	9.5	46.26	22.01	5.22	2.11	46.08	11.5	40.88
4	north	41159	M	67.6	24.32	23.72	8.26	8.26	5.48	11.72	18.94	4.94	9.09	4.01	14.71	21.11	5.31	42.26	22.24	3.92	2.16	44.09	9.51	40.17
4	north	41160	M	75.47	24.19	23.85	8.52	9.28	6.34	13.1	19.79	5.21	8.77	4.02	19.55	21.8	8.42	45.21	22.81	3.99	2.02	48.47	11.98	43.72
4	north	41161	M	77.68	25.83	24.22	9.25	8.77	5.14	13.18	19.45	5.15	8.63	4.12	19.22	23.01	8.45	46.78	23	4.65	1.93	47.07	11.53	44.68
4	north	41162	M	60.04	19.68	19.98	7.69	7.32	5.75	11.12	17.64	4.83	8.33	3.53	15.92	18.92	5.38	36.02	17.69	3.54	1.63	38.69	8.4	33.75
4	north	41163	M	74.98	26.79	25.43	9.17	9.42	6.52	12.33	19.48	5.1	8.95	4.73	18.09	21.87	8.09	45.06	20.96	4.93	1.99	46.46	9.97	42.84
4	north	41164	M	74.67	25.34	26.18	8.86	8.28	6.16	13.31	20.27	5.21	10.09	3.96	18.24	23.02	7.62	46.54	20.88	5.22	2.21	46.86	12.23	43.75
4	north	41166	M	74	22.89	22.97	9	9.43	5.82	12.82	19.26	4.79	8.45	3.88	16.38	23.41	6.86	46.16	19.57	4.05	1.56	45.25	9.98	39.84
4	north	41167	F	96.87	30.46	32.29	10.39	11.54	7.82	15.52	23.35	6.9	10.58	4.36	22.65	26.47	9.31	51.94	24.19	4.3	2.87	53.74	14.47	50.14
4	north	41168	M	68.71	21.35	22.55	7.39	8.13	5.11	11.65	18.07	5.08	7.67	4.39	16.61	20.73	6.39	41.39	19.67	3.53	1.64	44.31	9.42	36.02
5	north	103388	F	70.28	22.01	24.66	9.49	8.75	6.26	12.93	18.99	5.54	8.09	3.6	18.35	21.61	6.26	44.34	21.59	4.38	2.14	45.51	10.4	41.76
6	north	103385	F	81.49	25.08	25.67	10.28	9.49	7.31	13.28	21.04	5.14	9.48	3.71	19.52	22.65	9.88	45.02	22.14	4.25	2.46	46.02	13.35	43.68
7	east	6649	M	60.97	19.95	21.47	8.99	7.65	4.6	11.12	16.61	4.57	8.23	3.18	14.69	18.41	5.14	37.3	17.86	3.91	1.96	38.42	8.21	36.17
7	east	6650	M	75.74	22.76	23.96	10.24	8.92	6.36	12.75	19.19	5.19	9.03	4.02	16.04	18.88	5.86	42.51	20.69	3.99	1.83	43.42	9.42	40.81
7	east	6651	F	68.83	19.95	22.28	8.93	8.24	4.92	11.76	17.95	3.99	8.4	3.81	17.07	18.72	7.42	40.41	18.43	4.53	2.08	40.24	8.49	38.91
7	east	6653	M	80.42	24.11	26.04	10.16	8.91	5.59	13.47	19.3	5.66	9.18	4.58	18.55	24.01	6.89	45.03	21.98	4.43	1.89	49.08	9.74	46.97
7	east	6654	M	78.61	22.58	25.86	11.87	8.64	5.4	13.49	19.26	5.36	9.35	3.64	18.67	20.46	6.7	43.55	20.7	4.62	2.59	44.9	9.9	40.97
7	east	6656	M	58.89	19.5	20.66	8.86	7.02	4.29	11.13	16.27	4.96	7.86	3.55	14.62	17.33	5.55	35.84	17.32	3.15	1.73	37.26	7.78	35.26
8	east	103397	M	68.79	18.63	21.23	10.78	8.26	5.99	10.96	17.36	4.77	8.64	3.07	17.45	19.66	8.1	38.43	19.66	4.36	1.89	41.41	10.68	37.04
8	east	103398	M	65.16	17.51	21.93	9.93	8.43	5.82	11.46	17.92	4.82	7.71	3.75	17.28	20.14	7.84	38.5	19.7	3.29	1.8	40.64	9.91	38.71
8	east	103399	M	61.13	19.34	20.54	9.24	7.81	5.35	10	15.69	4.19	7.58	3.51	15.61	18.51	6.23	35.96	17.3	3.06	1.59	37.24	7.78	34.11
8	east	103400	M	65.5	19.7	21.62	8.8	8.55	6.05	10.95	17.02	4.89	8.04	3.78	16.29	19.17	7.32	38.41	18.61	3.83	1.78	40.49	9.49	37.43
8	east	103401	F	79.9	24.21	26.54	10.52	9.75	6.74	13.62	20.34	6.08	9.66	3.83	18.71	21.78	7.48	43.83	21.92	4.65	2.23	45.95	12.01	44.31
8	east	103402	F	71.62	21.93	24.92	10.23	8.82	6.43	11.82	19.87	5.59	8.29	3.95	17.97	22.56	6.08	44.02	21.6	3.86	2.13	45	10.44	42.61
8	east	103403	F	82.91	23.46	27.16	10.75	8.91	6.99	13.4	20.43	6.6	8.27	3.96	19.5	23.26	6.78	46.92	22.83	4.97	2	47.26	12.21	43.49

Continued Table S2

PopID	Group	labID	Sex	SVL	HL	HW	SL	IND	IOD	AOD	POD	END	ED	TD	HAL	FLL	FLW	FL	TSL	IMTL	IMTW	TL	TW	THL
8	east	103404	F	77.23	22.21	26.34	10.97	9.41	6.36	13.48	20.97	6.01	9.39	3.51	19.28	23.09	7.66	48.04	21.77	4.47	1.96	48.04	11.34	45.02
8	east	103405	F	85.01	24.71	28.65	10.8	10.71	7.65	13.9	20.87	5.46	8.89	3.82	21.59	21.08	8.1	52.1	23.95	5.67	2.2	50.87	12.35	47.09
9	south	1407II192	F	84.06	25.31	28.05	10.43	9.74	6.21	14.08	21.1	5.59	9.17	4.22	20.03	24.28	8.81	48.3	23.21	4.55	2.26	49.87	14.63	47.16
9	south	1407II194	M	72.04	23.06	27.37	9.43	8.81	5.26	12.65	19.85	6.06	9.28	3.69	19.15	22.15	8.19	45.91	22.96	4.08	1.76	47.64	11.18	43.42
9	south	1407II195	M	77.12	21.68	27.25	10.15	8.76	7.72	13.63	19.53	5.31	8.95	4.13	18.58	22.15	6.02	43.45	23.73	4.27	1.88	47.31	10.59	45.38
9	south	1407II196	M	71.5	22.04	26.78	10.89	8.69	4.89	12.15	17.83	5.18	7.89	3.71	18.04	21.59	5.98	44.14	21.72	3.28	1.71	45.08	9.9	41.43
9	south	1407II197	M	74.37	21.33	26.39	9.55	8.2	5.82	12.98	18.88	5.39	8.75	4.08	17.28	20.77	5.88	43.26	23.42	4.29	1.97	46.93	10.4	44.79
9	south	1407II198	F	79.33	23.66	26.27	11.55	8.99	5.67	12.95	20.86	5.6	8.96	3.73	18.73	22.41	9.67	46.45	21.01	4.29	1.66	48.38	11.85	44.32
9	south	1407II199	F	98.46	28.44	36.41	13.12	11.32	6.42	17.64	24.76	6.91	10.68	4.57	25.38	28.69	9.58	57.78	27.61	5.31	2.47	61.16	15.82	59.03
9	south	1407II200	M	77.27	23.13	28.01	9.95	9.12	5.39	13.33	19.26	5.93	9.44	3.76	19.17	24.19	5.51	45.38	22.4	4.52	1.92	48.42	11.44	46.14
9	south	1407II201	M	68.06	21.83	24.19	9.57	8.79	5.33	12.67	17.77	5.12	8.37	4	17.09	20.26	5.29	40.16	20.49	3.78	1.97	42.36	10.04	40.23
9	south	1407II213	F	80.75	23.86	26.69	10.05	8.58	4.61	13.34	21.24	5.05	9.54	3.24	19.28	23.31	9.84	45.86	21.81	4.31	1.66	47.77	12.41	45.53
10	south	103575	F	86.98	24.67	31.17	10.39	9.92	7.64	15.65	22.31	6.19	10.14	4.43	21.77	24.02	6.03	48.17	24.72	5.5	2.52	54.19	11.45	52.93
11	south	1507I239	F	89.6	25.65	33.16	10.83	10.1	8.03	16.55	25.67	6.63	10.89	4.82	22.78	28.18	8.03	55.74	25.33	4.86	2.55	56.4	13.92	49.4
11	south	1507I243	F	96.94	28.43	35.06	12.52	11.71	7.3	17.65	26.39	7.06	10.18	4.39	24	28.64	7.53	57.77	27.87	5.8	2.37	59.37	14.92	55.53
11	south	1507I250	M	69.21	20.79	24.29	7.88	7.5	5.37	12.26	18.3	4.8	9.3	4.12	16.91	21.11	6.83	43.35	21.49	4.28	1.6	44.95	11.2	43.34
11	south	1507I251	F	95.4	27.43	34.13	13.89	10.8	8.85	17.11	25.52	7.69	11.47	4.87	21.3	25.55	6.44	51.95	25.98	5.04	2.05	56.31	15.49	53.05
11	south	1507I252	F	89.28	25.48	33.16	11	11.07	5.91	16.42	24.58	6.4	10.57	4.87	23.22	28.26	8.14	60.25	26.74	5.93	2.48	58.35	15.71	55.33
11	south	1507I254	M	68.98	19.95	23.49	8.21	8.33	5.27	13.41	19.41	5.23	8.37	3.83	17.06	20	7.72	41.36	18.94	4.51	1.83	43.91	10.05	39.74
11	south	1507I257	M	71.56	22.1	23.27	9.34	8.05	5.76	12.02	19.05	5.37	8.2	3.6	17.13	20.53	8.23	42.99	20.59	4.03	1.76	45.42	11.2	41.5
11	south	1507I260	F	90.86	28.56	32.5	10.76	10.81	8.11	17.78	27.12	5.79	11.4	4.4	22.33	26.78	7.52	52.91	25.29	5.2	2.12	55.56	13.25	53.24
11	south	1507I261	M	70.68	21.33	25.48	9.04	7.4	6.09	12.83	19.34	5.25	8.58	4.27	19.2	22.46	7.21	45.93	21.74	4.45	1.93	45.39	10.99	43.88
11	south	1507I263	M	67	20.6	22.75	8.77	8.35	4.2	12.07	18.04	4.96	8.11	3.67	17.31	21.2	8.04	40.65	19.92	4.13	1.89	42.04	9.74	38.61
12	south	1408II059	F	80.5	24.95	27.82	10.73	9.79	6.12	14.45	21.27	6.24	9.49	3.93	20.7	22.86	7.29	46.15	23.27	4.36	2.06	49.07	12.2	44.32
12	south	1408II060	M	69.43	20.16	24.14	8.91	7.48	5.24	11.76	18.98	4.85	9.24	3.51	16.61	20.65	5.22	38.14	21.4	3.86	1.68	42.8	8.9	41.41
12	south	1408II061	M	77.99	21.86	26.16	9.93	8.49	5.78	12.7	20.23	5.53	8.38	3.72	19.31	22.78	8.28	47.51	21.76	4.97	2.03	48.28	11.16	46.19
12	south	1408II063	M	75.49	22.08	26.72	9.06	8.57	5.43	12.01	19.52	5.36	9.19	4.11	17.88	22.09	5.28	44.75	23.52	3.88	1.8	47.37	11.19	44.8
12	south	1408II064	F	89.97	24.93	29.58	10.81	9.84	5.58	15.17	20.8	6.01	9.34	4.92	20.7	26.44	8.06	52.04	24.27	4.65	2.11	55.09	12.87	51.59
12	south	1408II065	M	65.94	21.6	21.85	8.48	7.7	5.09	10.96	15.62	4.87	7.95	3.75	16.27	19.08	7	38.85	18.81	4.2	2.17	40.38	8.66	38.25
12	south	1408II066	M	78.83	24.71	25.59	9.84	8.31	6.13	12.23	19.87	5.98	9.33	4.09	18.02	22.2	8.91	44.42	20.94	4.2	1.78	46.57	12.64	47.04
12	south	1408II067	F	91.58	26.47	30.43	10.88	10.25	7.2	14.98	22.61	6.38	10.36	3.99	21.09	23.72	8.16	52.01	23.41	6.71	2.09	53.32	14.31	50.01
12	south	1408II068	M	64.41	18.24	22.05	6.58	6.95	4.76	10.61	17.05	4.66	8.74	3.38	15.43	19.37	5.69	38.63	18.84	2.91	1.62	41.03	8.68	39.16

Continued Table S2

PopID	Group	labID	Sex	SVL	HL	HW	SL	IND	IOD	AOD	POD	END	ED	TD	HAL	FLL	FLW	FL	TSL	IMTL	IMTW	TL	TW	THL
13	south	103579	F	86.04	23.84	31.24	10.17	10.8	7.2	15.06	22.64	6.55	10.07	5.06	22.56	25.04	6.59	50.73	25.18	4.97	2.44	51.25	13.03	50.29
13	south	103580	F	89.08	27	31.34	12.02	10.74	6.63	14.81	22.17	5.91	10.7	4.79	23.24	26.19	8.57	53.32	26.33	5.53	2.12	53.04	14.2	52.56
13	south	103678	F	87.03	24.95	29.37	10.9	9.97	8.32	15.62	22.56	7.08	9.92	4.33	22.69	26.67	7.3	52.19	24.93	5.22	1.9	54.75	11.83	52.51
14	west	103414	M	78.88	23.62	27.03	10.56	9.69	5.62	13.84	22.23	6.05	9.29	4.8	20.65	24.69	8.32	50.86	22.35	5.16	2.09	49.08	12.51	45.62
14	west	103442	F	105.4	26.59	35.22	13.94	11.28	8.56	17.33	26.14	7.76	9.51	4.33	25.18	28.21	8.6	56.85	26.67	6.05	2.37	59.38	15.64	58.67
14	west	103609	M	79.04	23.54	27.02	10.05	9.33	7.06	13.39	21.23	5.73	8.79	3.62	20.44	22.94	7.02	47.84	22.71	4.69	1.95	49.7	11.05	47.29
14	west	103610	M	72.13	21.47	24.34	10.35	8.3	5.41	11.73	18.12	5.7	7.96	3.55	18	20.54	7.77	42.98	20.16	4.08	1.91	44.82	9.8	42.44
14	west	103611	M	72.58	23.74	24.77	11.18	9.52	6.17	12.97	19.57	6.14	9.39	3.66	19.2	22.65	8.2	46.97	21.89	4.12	1.82	48.41	10.37	45.86
14	west	103612	F	89.57	26.96	30.93	12.01	11.48	8.61	16.32	23.73	6.21	9.52	4.05	21.6	26.27	7.44	52.3	25.84	4.85	2.69	56.1	13.87	53.67
14	west	103613	M	73.13	23.93	24.29	10.54	8.51	6.3	12.64	20.03	5.46	8.68	4.02	18.74	24.12	8.25	46.54	21.73	4.41	2.02	46.04	9.71	43.34
14	west	103614	M	74.15	21.91	25.99	9.5	9.42	7.16	12.91	19.68	5.11	9.43	3.82	18.89	22.36	8.06	45.84	22.77	4.27	2.13	46.73	9.42	45.47
14	west	103616	M	79.1	24.36	25.56	10.75	8.93	6.07	12.76	19.3	5.46	7.98	4.36	19.71	21.32	7.67	44.98	22.52	3.81	1.36	45.99	10.99	44.56
14	west	103617	F	81.12	25.77	30.85	9.65	9.53	6.52	14.97	23.01	6.94	9.77	4.12	21.39	26.28	7.5	52.99	25.78	5.04	2.4	51.36	12.72	48.42
14	west	103618	F	90.98	31.18	33.49	11.97	11.33	9.61	16.3	26.34	6.99	11.25	4.78	19	27.63	9.61	58.1	26.34	5.95	2.41	59.33	14.45	57.44
15	west	90512	M	76.23	21.96	24.33	9.42	8.09	6.31	12.42	19.36	5.59	7.83	3.49	19.61	21.26	8.22	45.43	20.39	5.15	2.16	44.64	10.75	43.51
15	west	90513	F	90.89	26.13	32.1	10.5	10.15	6.3	15.96	23.12	7.07	9.88	3.96	21.89	26.36	8.53	52.95	26.18	4.36	2.65	53.45	13.64	51.1
15	west	90514	M	76.18	21.48	24.93	9.51	9.3	5.63	13.05	20	4.71	9.64	3.59	20.53	23.04	9.91	46.1	21.36	4.69	1.9	45.26	11.53	44.72
15	west	90515	F	92.96	24.68	30.92	11.64	10.23	6.89	15.24	23.78	6.16	10.86	4.04	22.94	25.73	7.7	52.55	23.34	5.71	2.18	54.7	12.38	52.31
15	west	90516	M	71.05	20.65	22.41	9.06	7.79	5.63	12.06	18.15	5.25	8.14	3.33	18.08	20.79	7.52	43.99	19.34	4.18	1.54	42.56	9.95	40.91
15	west	90517	M	75.21	21.87	25.23	10.18	8.93	5.09	13.42	20.54	4.84	8.69	3.45	20.99	23.44	8.56	47.17	22.64	4.78	2.55	44.96	12.53	45.43
15	west	90518	F	94.76	24.71	32.33	11.54	10.34	7.5	15.86	22.95	6.15	10.15	4.13	24.99	26.6	8.55	55.28	26.77	5.97	3.1	56.21	14.44	54.68
15	west	90519	M	76.69	21.37	25.37	9.52	8.71	5.98	12.3	18.67	4.93	8.88	3.75	19.12	21.46	9.79	42.49	21.58	4.65	1.68	43.71	12.18	41.73
15	west	90520	F	93.45	25.51	32.21	12.08	10	5.85	17.06	23.65	5.84	9.98	3.99	22.7	25.61	8.92	52.11	24.44	5.41	2.38	52.5	13.13	51.55
16	west	103450	F	68.55	23.02	23.92	7.77	9.22	5.24	12.27	18.91	4.4	8.95	3.37	16.2	21.47	5.04	41	20.46	3.61	1.61	42.28	8.92	38.78
16	west	103451	M	71.62	21.63	25.42	9.54	10.1	6.02	14.73	22.38	5.75	8.8	3.89	18.59	21.68	7.78	42.4	19.63	4.77	1.98	43.3	11.33	41.18
16	west	103452	F	96.32	29.18	34.59	11.32	13.18	10.24	18.7	27.3	6.94	9.88	4.68	24.83	29.16	9.68	58.96	27.98	6.12	2.37	59.34	15.95	56.59
16	west	103453	M	79.92	27.77	27.75	9.22	10.27	7.39	15.47	22.42	6.07	9.74	3.46	19.98	22.1	9.03	48.07	21.87	4.79	1.65	47	13.71	45.94
16	west	103456	F	97.66	28.17	34.35	9.81	10.94	8.11	16.34	25.64	5.92	10.59	3.92	25.59	29.03	9.84	59.87	26.78	5.65	2.23	59.87	16.65	57.44
16	west	103457	M	68.57	23.27	25	8.9	8.83	5.94	13.16	19.64	5.18	8.44	4.39	17.46	20.83	9.48	42.56	21.56	4.41	2.18	44.83	11.12	43.04
16	west	103458	M	77.26	23.94	25.25	8.84	9.27	5.26	14.45	22.08	5.48	8.42	3.9	18.95	21.26	9.11	43.72	20.54	4.94	2	46.22	13.13	44.61
16	west	103459	M	79.6	24.7	26.09	9.44	8.98	7.18	13.23	21.72	6.1	7.99	4.04	19.42	22.1	9.88	47.12	21.23	4.43	1.9	47.35	12.58	46
16	west	103460	M	76.92	23.17	25.45	9.98	8.7	6.17	13.27	21	5.55	8.94	4.74	18.74	21.75	8.36	43.71	20.32	4.52	1.82	44.71	12.76	43.4

Continued Table S2

PopID	Group	labID	Sex	SVL	HL	HW	SL	IND	IOD	AOD	POD	END	ED	TD	HAL	FLL	FLW	FL	TSL	IMTL	IMTW	TL	TW	THL
16	west	103462	F	67.96	25.53	24.4	10.2	10.01	4.54	14.34	20.7	5.58	8.96	4.83	22.84	19.37	9.25	39.59	19.07	4.33	1.97	42.83	10.8	38.95
16	west	103463	M	76.47	23.07	25.87	9.8	9.07	7.15	13.67	19.32	5.26	8.39	4.42	19.6	21.69	8.83	44.48	21.98	4.18	2.04	47.37	11.44	44.73
16	west	103464	F	82.58	25.35	30.34	11.99	9.58	6.6	14.64	21.24	5.89	9.79	4.23	20.61	25.99	6.66	49.87	23.14	4.67	2.02	52.14	11.84	49.69
16	west	103465	F	91.12	28.76	32.09	11.53	11.29	7.08	15.6	24.4	6.83	10.53	4.83	22.9	26.51	7.61	52.18	27.21	4.98	2.24	57.11	14.17	53.65
16	west	103467	F	98.7	30.59	36.07	13.56	13.23	7.84	16.88	26.44	5.27	10.78	4.65	24.77	26.94	11.8	55.67	26.49	5.91	2.62	58.41	15.98	57.08
16	west	103471	F	94.49	26.43	31.32	12.59	10.54	7.72	14.9	22.18	6.66	10.01	4.63	22.43	24.16	7.17	51.16	25.81	5.15	2.11	54.7	14.03	52.24
16	west	103488	F	86.54	27.23	29.77	12.66	10.42	6.72	16.83	24.7	5.67	9.53	4.82	21.82	25.81	6.51	51.69	22.85	4.76	1.97	52.22	12.07	51.15
17	west	107621	M	72.55	22.7	27.42	10.03	9.07	5.72	14.1	21.64	6.17	9.78	3.85	20.68	22.44	8.23	46.65	23.78	4.44	2.3	49.83	10.13	47.11
17	west	107622	M	72.27	21.48	25.15	9.43	8.48	7.84	13.95	21.16	5.27	9.66	3.91	20.01	20.98	8	44.63	21.5	4.52	1.92	46.48	10.68	43.6
17	west	107623	M	77.36	21.28	27.49	9.56	9.39	7.35	13.54	21.02	5.17	9.66	3.61	20.14	22.09	9.44	36.38	22.17	5.04	2.16	47.74	11.74	46.45
18	west	91672	F	106.97	28.55	36.14	12.35	12.5	6.81	17.73	25.62	6.56	10.34	4.67	24.41	28.33	9.19	55.39	26.44	5.98	3.03	57.65	15.9	56.36
18	west	91673	F	104.45	28.1	35.59	11.81	11.39	8.09	17.62	26.66	6.21	10.91	4.65	24.56	27.93	9.82	58.17	27.95	5.96	2.64	58.46	15.42	56.75
18	west	91674	F	106.26	27.77	36.46	12.06	11.92	7.88	18.5	25.57	6.31	11.01	4.68	25.03	28.81	8.08	57.78	28.36	6.77	3.36	59.15	16.62	56.56
18	west	91675	F	106.46	29.39	37.74	12.52	11.37	8.45	18.83	26.84	7.02	9.8	4.95	26.13	30.2	10.17	61.36	29.02	6.01	2.66	60.3	17.02	58.8
18	west	91676	F	109.69	29.29	36.65	12.35	11.67	8.43	18.49	26.24	6.82	11.18	4.47	21.29	27.96	10.28	58.02	28.24	6.88	2.72	60.73	17.8	57.26
19	west	150407	M	65.83	20.11	22.9	8.6	8.21	5.91	12.47	18.77	5.23	9.3	4.05	17.39	20.51	7.65	39.23	19.48	4.22	1.95	42.26	8.53	39.64
19	west	150408	M	74.74	21.49	24.13	8.46	7.91	5.54	12.79	19.65	5.13	8.94	4.09	17.22	21.8	7.34	43.58	21.02	4.17	2.19	44.17	10.26	42.35
19	west	150413	M	78.03	21.47	25.29	10.36	9.1	6.32	13.64	19.95	5.56	9	3.55	18.31	21.37	8.75	44.07	21.1	4.75	2.03	45.7	10.93	42.24
19	west	150423	F	86.19	26.26	30.63	11.33	10.14	6.7	15.78	22.51	6.15	7.57	3.95	21.62	23.76	7.95	51.84	24.39	5.35	2.56	51.8	12.64	48.36
20	west	6482	M	78.66	22.66	25.87	10.1	9.22	6.18	13.78	20.47	5.31	9.84	3.87	20.08	21.88	7.07	45.1	21.07	4.08	1.9	46.57	10	45.67
20	west	6483	M	79.43	24.07	27.92	10.88	8.82	6.89	14.77	21.34	5.88	9.76	4.41	20.28	22.87	8.19	46.79	20.83	4.87	2.45	48.07	10.62	46.11
20	west	6484	F	95.61	27.77	33.43	11.4	11.05	8.67	15.79	24.16	6.63	11.44	4.48	23.77	25.77	8.63	54.54	24.91	5.59	2.63	55.34	12.87	54.25
20	west	6485	F	81.32	24.73	29.65	11.05	9.39	5.85	15.01	22.58	6.48	9.86	4.58	20.64	23.12	6.88	48.91	22.48	4.47	2.32	50.27	10.13	47.51
20	west	6486	M	71.44	20.27	24.3	9	7.84	5.26	12.48	18.17	5.4	9.56	3.85	17.64	18.49	7.25	42.65	20.54	4.19	2.3	43.63	9.05	42.07

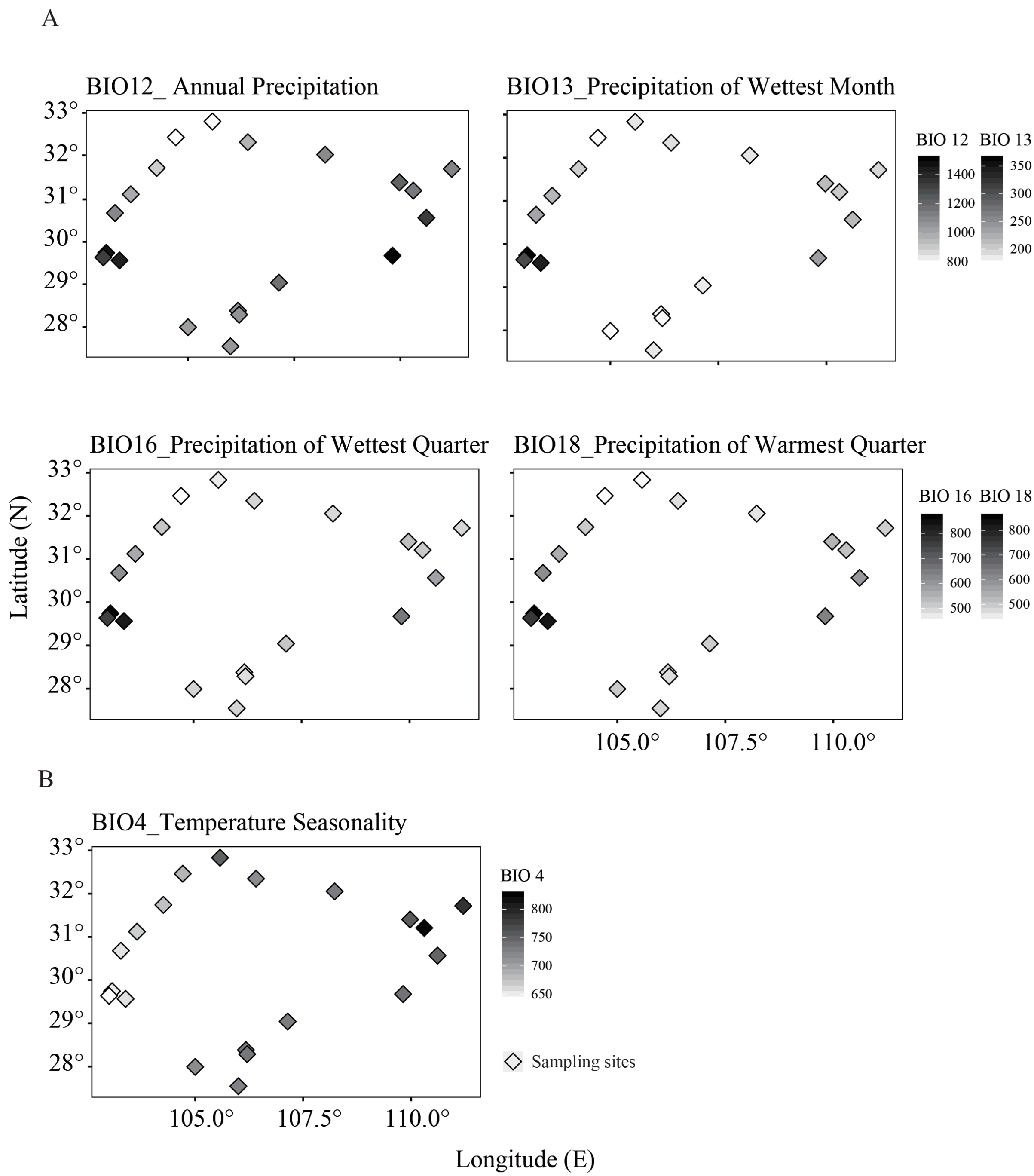

Figure S1 A: Patterns of geographical variation in precipitation related factors; B: Patterns of geographical variation in temperature related factors. For (A–B), mean values from every site were plotted in coordinates, and the grey scale of symbols is according to increasing size.

Table S3 The mean PC1 scores of PCA conducted on 21 morphological characters for individuals from each site. Males and females are shown separately.

Site	Group	Male	Female
1	north	–	−6.25
2	north	−0.71	−13.5
3	north	−2.5	−6.9
4	north	0.27	1.45
5	north	–	−29.96
6	north	–	−11.11
7	east	−11.27	−41.29
8	east	−12.79	−11.46
9	south	2.88	−1
10	south	–	2.13
11	south	−2.81	12.57
12	south	2.88	−2
13	south	–	3.59
14	west	6.67	11.51
15	west	3.24	8.99
16	west	5.59	3.07
17	west	5.32	–
18	west	–	27.04
19	west	−0.7	0.52
20	west	5.56	3.63